I. INTRODUCTION

This assessment accompanies a supplemental notice of proposed rulemaking to upgrade the agency's occupant protection standard to improve occupant protection provided by air bags. While current air bags have been shown to be highly effective in reducing overall fatalities and injuries, sometimes their deployment has resulted in fatalities to out-of-position occupants, especially children. The agency's proposal seeks both to improve air bag performance and to minimize the risks from air bags.

NHTSA is proposing new performance requirements as a step toward further reducing risks of air bags to out-of-position occupants. The proposed amendments would provide options to manufacturers to account for the differing kinds of technological solutions that may be used to address this problem, e.g., technologies that enable air bags to deploy in a manner so they do not result in serious injuries or which suppress air bag deployment in the presence of infants or out-of-position occupants.

September 1998 Notice of Proposed Rulemaking:

On September 18, 1998, NHTSA published in the **Federal Register** (63 FR 49958) a notice of proposed rulemaking (NPRM) to upgrade Federal Motor Vehicle Safety Standard (FMVSS) No. 208, Occupant Crash Protection, to require advanced air bags. The advanced air bags would be required in some new passenger cars and light trucks beginning September 1, 2002, and in all new cars and light trucks beginning September 1, 2005.

As was explained in that notice, air bags have been shown to be highly effective in saving lives. They reduce fatalities in frontal crashes by about 30 percent. However, they also sometimes cause fatalities to out-of-position occupants.

The September 1998 notice presented a full discussion of the safety issues related to air bags. It also included a discussion of a comprehensive plan to address air bag fatalities, which includes requiring advanced air bags as a long-term solution.

The NPRM proposed to add a new set of requirements to prevent air bags from causing injuries and to expand the existing set of requirements intended to ensure that air bags cushion and protect occupants in frontal crashes. There would be several new performance requirements to ensure that the advanced air bags do not pose unreasonable risks to out-of-position occupants.

The proposal included options for complying with those requirements so that vehicle manufacturers would be free to choose from a variety of effective technological solutions and to develop new ones if they so desire. With this flexibility, they could use technologies that control air bag deployment so deploying air bags do not cause serious injuries or that prevent air bag deployment if children or out-of-position occupants are present.

To ensure that the new air bags are designed to reduce the chance of causing injury to a broad array of occupants, NHTSA proposed test requirements using dummies representing 12-month-old, 3-year-old and 6-year-old children, 5th percentile adult females, and 50th percentile adult

males. Many of the proposed test procedures were new, and comments were specifically requested with respect to their suitability for measuring the performance of the various advanced systems under development.

NHTSA proposed requirements to ensure that the new air bags are designed to cushion and protect a broader array of belted and unbelted occupants, including teenagers and small women. The standard's current dynamic crash test requirements specify the use of 50th percentile adult male dummies only. NHTSA also proposed to specify use of 5th percentile adult female dummies for these tests. The weight and size of these dummies are representative of not only small women, but also many teenagers.

NHTSA also proposed to add a deformable barrier crash test. This proposed new crash test requirement was intended to ensure that air bag systems are designed so that the air bag deploys earlier in crashes with softer crash pulses, before normally seated occupants, including small-statured ones, move too close to the air bag. NHTSA proposed to use 5th percentile adult female dummies in this test.

NHTSA also proposed to phase out the unbelted sled test option as vehicle crash test requirements for advanced air bags are phased in. Although it was believed that the sled test option has been a useful temporary measure to ensure that the vehicle manufacturers could quickly depower all of their air bags and to help ensure that some protection would continue to be provided, NHTSA did not consider sled testing to be an adequate long-term means of

assessing the extent of occupant protection that a vehicle and its air bag will afford occupants in the real world.

Finally, NHTSA proposed new and/or upgraded injury criteria for each of the proposed new test requirements, and also proposed to upgrade some of the injury criteria for the standard's existing test requirements.

A number of events relevant to this rulemaking have occurred since publication of the NPRM in September 1998. First, the development of advanced air bags by suppliers and vehicle manufacturers has continued. Acura introduced dual stage passenger side air bags in their MY99 Acura RL. According to Acura s press release, (t)he dual stage air bags were designed to reduce the inflation speed to help protect children or small-framed adults. In a low speed collision, the dual-stage inflator system is triggered in sequence resulting in slower air bag deployment with less initial force. In higher speed collisions, both inflators operate simultaneously for full immediate inflation. The air bag system logic also controls the operation of the seat belt pretensioners. A new feature of the system detects whether the passenger s seat belt is fastened. If the seat belt is not fastened, the air bag deploys a full force at a lower collision speed to help offer more protection to the unbelted occupant.

Ford made a public announcement in January 1999 that it will introduce advanced technology enabling its cars and trucks to analyze crash conditions and activate safety devices to better protect a range of occupants in a variety of frontal crash situations. Ford stated that its Advanced

Restraints System features nearly a dozen technologically advanced components that work together to help front-seat occupants receive significantly enhanced protection during frontal crashes, taking into account their seating position, safety belt use and crash severity. That company indicated that elements of the system, which features technologies such as improved crash severity sensors, a driver-seat position sensor, a passenger weight sensor, safety belt usage sensors, dual-stage inflating air bags, safety belt pretensioners and energy management retractors, will debut on vehicles beginning this year. Ford stated that the company will introduce these new technologies on new and significantly freshened models until all its passenger cars, trucks and sport utility vehicles have the complete Advanced Restraint System.

GM made a public announcement in February 1999 that it will introduce technology in the 2000 model year that is designed to detect the presence of a small child in the front passenger seat of its vehicles and suppress the deployment of the frontal air bag in the event of a frontal crash. This technology consists of weight-based sensors coupled with pattern recognition technology. GM stated that it will introduce this technology on the Cadillac Seville in the 2000 calendar year, and that it has a very aggressive roll-out plan that extends this technology throughout its product line.

NHTSA has also received more detailed confidential information from GM and Ford concerning their plans, as well as confidential information from other auto manufacturers concerning their latest plans to introduce various advanced technologies.

Second, on November 23 and 24, 1998, NHTSA held a public meeting to get comments on two technical papers issued by NHTSA relating to our proposal to require advanced air bags. These papers were entitled: Development of Improved Injury Criteria for the Assessment of Advanced Automotive Restraint Systems and Review of Potential Test Procedures for FMVSS No. 208".

Third, in April 1999, NHTSA held a technical workshop concerning biomechanical injury criteria. This workshop provided an additional opportunity for a continuing dialog with the biomechanics community to assure that we considered appropriate injury criteria.

Fourth, NHTSA has analyzed the public comments and also conducted additional testing. A summary of the comments is included in the supplemental notice published with this analysis. Specific comments are addressed as appropriate throughout this analysis.

The Supplemental Notice of Proposed Rulemaking:

Based on information gathered and research conducted since the NPRM, NHTSA has modified its

proposal. The agency is proposing tests to minimize the risks to infants, children, and other occupants from injuries and deaths caused by air bags (see Figure I-1).

The agency is proposing two alternatives for dynamic frontal crash tests. One of these includes a return to the 30-mph unrestrained rigid barrier test and adds other requirements to the standard's dynamic frontal crash test requirements to enhance protection for a wider range of occupants.

The current dynamic crash test requirements specify use of 50th percentile male dummies. The agency is proposing those same requirements also be met using 5th percentile female dummies. In addition, the agency is proposing to add a new dynamic offset deformable barrier crash test. This test is intended to ensure that air bags deploy sufficiently early in a crash, before normally seated occupants move too close to the air bag. This up to 25 mph test into an offset deformable barrier using belted 5th percentile female dummies was initially proposed in the NPRM. The second alternative includes a second offset deformable barrier test which must be passed at any speed between 22-35 mph using both 5^{th} female and 50^{th} male unbelted dummies. In addition to protecting out-of-position occupants, this test may result in improved vehicle structural integrity. The agency is also proposing specifications for the deformable barrier to be used in this test. The addition of a broader array of adult size test dummies and crash tests would improve protection for all occupants by requiring more thorough evaluation of a vehicle's occupant protection system.

The SNPRM is proposing two alternative test groupings for the high speed tests discussed above. These groupings are summarized in Figure I-2 and Figure I-3. Requirements for tests to reduce injury to the at-risk population are shown in Figure I-1. These tests would be required with each of the two alternative groupings for high speed tests shown in Figures I-2 and I-3.

The agency is considering alternative speeds and effective dates for Alternative 1. Under consideration for Alternative 1 is an unbelted 29 to 40 kmph (18 to 25 mph) test for a temporary time that would increase at a later time to a permanent 29 to 48 kmph (18 to 30 mph) test. Also,

under consideration is an unbelted 29 to 40 kmph (18 to 25 mph) frontal rigid barrier test coupled with an increase in the belted test from the current up to 48 kmph (30 mph) to a 56 kmph (35 mph) test. The belted up to 56 kmph (35 mph) test may have a later effective date than the effective date of the unbelted 29 to 40 kmph (18 to 25 mph) test. These are not shown in Figure 1-2.

The SNPRM also proposes new injury criteria for the existing 50th percentile male dummy, as well as injury criteria for the new dummies (12-month old infant, 3-year old child, 6-year old child, and 5th percentile female dummy). The criteria proposed in the SNPRM differ from those proposed in the NPRM. A detailed discussion of these criteria is provided within the analysis in Chapter III.

Figure I-1

Test Requirements to Minimize the Risk to Infants
Children and Other Occupants from Injuries
And Deaths Caused by Air Bags

Figure I-2
High Speed Test Requirements to Preserve and Improve Occupant Protection

Alternative 1

Figure I-3
High Speed Test Requirements to Preserve and Improve Occupant Protection

Alternative 2